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LITIGATION TECHNICAL SUPPORT AND SERVICES

ROCKY MOUNTAIN ARSENAL

FINAL PHASE I
CONTAMINATION ASSESSMENT REPORT
SITE 36-3: INSECTICIDE PIT
(Version 3.3)

June 1987
Contract Number DAAK11-84-D0016
Task Number 1 (Section 36)

Rocky

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

HARDING LAWSON ASSOCIATES MIDWEST RESEARCH INSTITUTE

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AMXRM-PM ABERDEEN PROVING GROUND,
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PROGRAM MANAGER'S OFFICE FOR

ROCKY MOUNTAIN ARSENAL CLEANUP

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PREPARED BY

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Harding Lawson Associates Midwest Research Institute

PREPARED FOR

U.S. ARMY PROGRAM MANAGER'S OFFICE FOR ROCKY MOUNTAIN ARSENAL

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13. ABSTRACT *(Maximum 200 words)*

THIS FINAL REPORT DOCUMENTS THE PHASE I CONTAMINATION SURVEY OF SITE 36-3, A SERIES OF TRENCHES AND PITS BELIEVED TO HAVE BEEN USED FOR DISPOSAL OF INSECTICIDES.

16 SAMPLES FROM 8 BORINGS WERE ANALYZED FOR VOLATILE AND SEMIVOLATILE ORGANICS AND METALS WITH SEPARATE ANALYSES FOR HG, AS, AND DBCP. PREDOMINANT CONTAMINANTS ARE HG, ALDRN, AND DLDRN; HOWEVER, AS, CD, PB, ENDRN, ISODR, CPMS, CPMSO, CPMSO2, DBCP, C6H6, CH2CL2, DCPD, CHCL3, BCHPD, TCLEE, AND MEC6H5 WERE ALSO DETECTED ABOVE THEIR RESPECTIVE INDICATOR RANGES. METAL ANOMALIES MAY ALSO BE PRESENT AT THE SITE.

A PHASE II PROGRAM CONSISTING OF 28 ADDITIONAL BORINGS IS RECOMMENDED TO 1) DEFINE THE OUTER EXTENT OF SOIL CONTAMINATION AND 2) CONFIRM THE ACCURACY OF THE GEOPHYSICAL INVESTIGATION IN IDENTIFYING THE DISPOSAL TRENCHES. THE VOLUME OF CONTAMINATED SOIL PRESENT IS ESTIMATED AT 73,000 BANK CUBIC YARDS.

APPENDICES: CHEMICAL NAMES, PHASE I CHEMICAL DATA, COMMENTS AND RESPONSES.

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APPENDIX 36-3-C

COMMENTS AND RESPONSES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET—SUITE 500
DENVER, COLORADO 80202-2405

SEP 14 1987

REF: 8HWM-SR

Colonel W. N. Quintrell
Program Manager
AMXRM-EE Department of the Army
U.S. Army Toxic and Hazardous Materials Agency
Building 4460
Aberdeen Proving Ground, MD 21010-5401

Re: Rocky Mountain Arsenal (RMA),
Review of Final Phase I CAR Report for
Task 1, Site 36-3 Insecticide Pit

Dear Colonel Quintrell:

EPA Region VIII has reviewed the above referenced final report and has the enclosed preliminary comments from our contractors. Given the status of Phase II Investigation work at this site and the nature of the enclosed comments, it may be that our concerns can be addressed during the Feasibility Study for RMA. If you wish to pursue that option, please call Mr. Connally Mears at (303) 293-1528.

Sincerely yours,

Robert L. Duprey, Director
Hazardous Waste Management Division

Enclosures

cc: David Shelton, CDH
Chris Hahn, Shell Oil Company
R. D. Lundahl, Shell Oil Company
Thomas Bick, Department of Justice
Elliott Laws, Department of Justice

87885-1/2

RESPONSES TO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE FINAL TASK 1 REPORT SITE 36-3: INSECTICIDE PIT

Comment_1: Figure 36.3-6 [sic] should show the location of trenches based on aerial photos.

Response: The trench locations were not placed on the figure due to the complex nature of the site which made such a presentation confusing and potentially misleading. The geophysical investigation generally detected high response levels and intense anomalies, such that it was very difficult to delineate trench and intertrench material. Maps presented in the geophysical report display these results, and explain that no direct correlation between trenches indicated on aerial photographs and geophysical anomalies was possible due to these uncertainties. The proposed investigation of suspected trench locations is based on the chemical and geophysical data. Further attempts to map trench locations will be made when additional data is gathered through Phase II borings.

Comment_2:
p. 12 The Phase II survey should be revised to include an evaluation of the metallic anomalies discovered during the Phase I investigation. Containerized wastes could have been disposed of at this site and their presence would effect the remedial action required.

Response: The Phase I geophysical investigation was used to identify potential sites of buried wastes within Site 36-3. Some areas do contain containerized wastes, as drums are observable at the surface. Such information is recorded in field logs. No borings can be placed within these areas for safety reasons, thus the anomalies have been investigated to the extent possible. Evaluation of the metallic and other anomalies will be continued in conjunction with Feasibility Studies.

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EXECUTIVE SUMMARY

SITE 36-3: INSECTICIDE PIT

Site 36-3, the Insecticide Pit, is a landfill in the southeastern portion of Section 36 on Rocky Mountain Arsenal. This site was investigated under Task 1 in the summer of 1985. The site was used for trench disposal of various wastes beginning in 1953. Trenches were dug as needed to depths of 6 to 10 feet (ft), mostly in an east-west direction. Eight Phase I borings were drilled to depths of 3 to 10 ft and yielded 16 samples.

The following target constituents were detected above their respective indicator ranges: arsenic, mercury, cadmium, lead, aldrin, dieldrin, endrin, isodrin, chlorophenylmethyl sulfide, chlorophenylmethyl sulfoxide, chlorophenylmethyl sulfone, dibromochloropropane, dicyclopentadiene, benzene, chloroform, methylene chloride, bicycloheptadiene, tetrachloroethene, and toluene. Predominant contaminants are mercury, aldrin, and dieldrin. Volatile organic compounds were detected near the water table. Five borings contained chlorinated nontarget analytes which appear to be associated with the target organochlorine pesticides. Phase I results indicate soil contamination at the site and possible impacts on areas outside the Phase I site boundaries. A geophysical investigation, conducted following Phase I, confirmed the presence of trenches. Supporting documentation of the disposal practices at this site is available.

A Phase II program consisting of 28 additional borings yielding 75 samples is proposed to better define the lateral and vertical extent of contamination and to investigate possible impacts on areas outside the Phase I site boundaries. The Phase II program will also address the extent of contamination caused by chlorinated nontarget compounds and associated target organochlorine pesticides. The estimated volume of contaminated material in the unsaturated zone at this site has been revised from 23,000 bank cubic yards (bcy) to 73,000 bcy.

SITE 36-3: INSECTICIDE PIT

1.0 PHYSICAL SETTING

1.1 LOCATION

Site 36-3 is in the southern portion of a large complex disposal area (Site 36-17). The site covers about 1.5 acres (map estimates) in the south-central portion of Section 36 (Figure 36-3-1) at a surface elevation of 5,250 feet above mean sea level (ft msl).

This site is a series of pits and trenches thought to have been used for insecticide and pesticide disposal. Previous estimates of contaminated soil at this site were an areal extent of 61,000 square feet (ft^2) and a volume of 23,000 bank cubic yards (bcy) (RMACCPMT, 1984, RIC#84034R01).

After examination of aerial photographs and field reconnaissance, the areal extent of this site was expanded. Trenching activity at this location apparently occurred over a much larger area than originally estimated. Although much of this additional trench disposal may not have resulted from pesticide activities, aerial photographs show these trenching activities occurring at the same time as similar activities within the original Site 36-3 boundaries. Therefore, the areal extent was revised to 230,000 ft^2 for the Phase I investigation to include other potential disposal sites at Rocky Mountain Arsenal (RMA) (Figure 36-3-1).

1.2 GEOLOGY

Site 36-3 is on the southeastern edge of Basin A. Cross sections indicate that the alluvial thickness is approximately 19 to 25 feet (ft). Surficial materials are predominantly unconsolidated alluvial and eolian deposits of Quaternary age and include alluvial fill, dune sand, and glacial outwash. Sediments are comprised of cobbles, boulders, and beds of volcanic ash as well as sand, gravel, silt, and clay (May, 1982, RIC#82295R01).

The Denver Formation, which forms the bedrock surface in the area, consists of 250 to 400 ft of olive, bluish-gray, green-gray, and brown

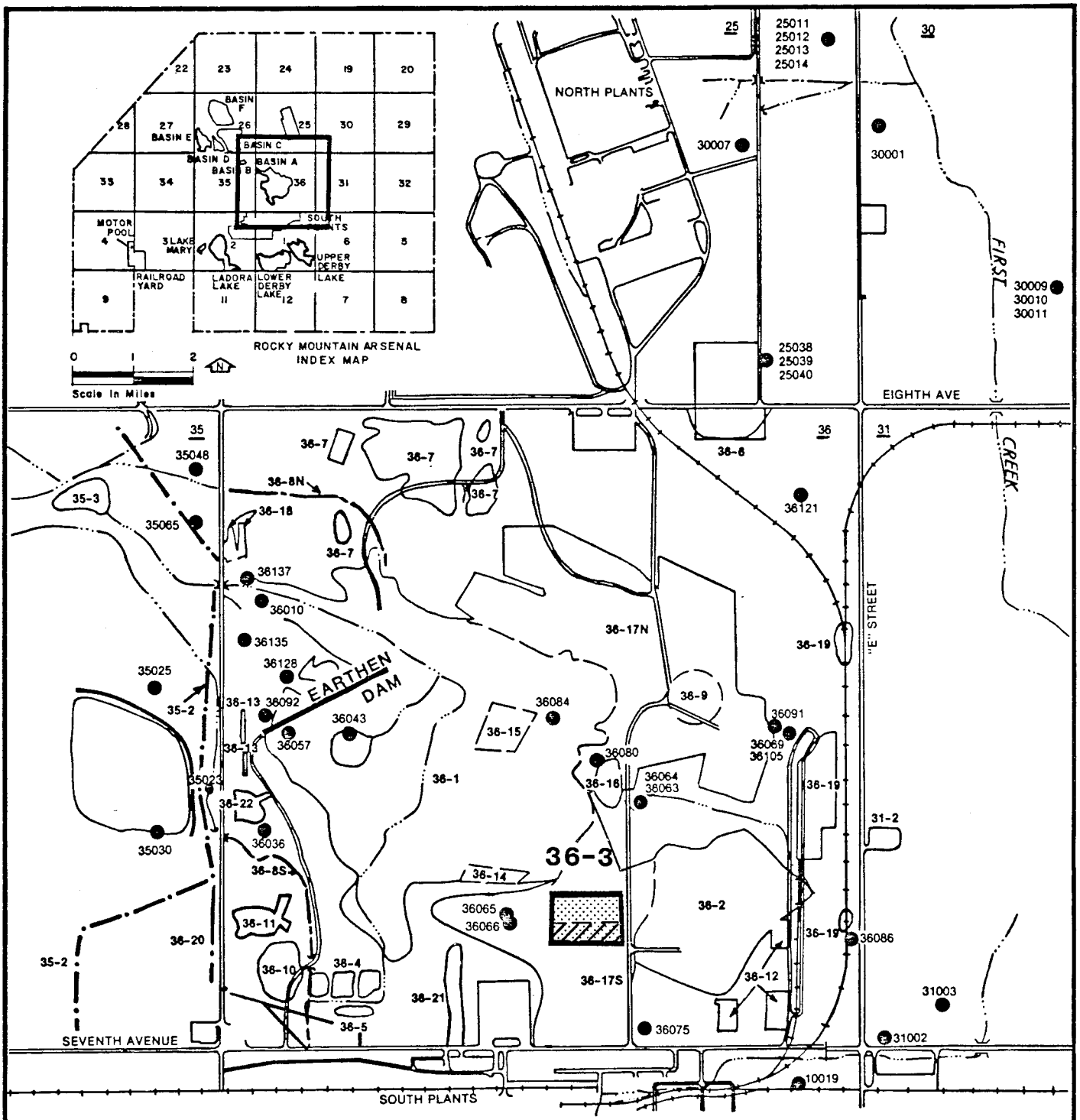

Figure 36-3-1
SITE LOCATION MAP
SITE 36-3
ROCKY MOUNTAIN ARSENAL
SOURCE: HLA,1987

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

clay-shale and siltstone interbedded with poorly sorted, weakly lithified tan to brown, fine- to medium-grained sandstone. Lignite beds and carbonaceous shale are common, as are volcanic fragments and tuffaceous material. The clay-shale is largely bentonitic. Sandstones are mainly lenticular and sinuous. These lenses are distributed within thick clay-shale sequences and are poorly defined where the sandstone grades into the encompassing clay and shale. The sandstones are discontinuous to semi-continuous (RMACCPMT, 1983, RIC#83326R01; May, 1982, RIC#82295R01).

The results of the Phase I boring program confirmed that Site 36-3 is underlain by alluvial material consisting of silty sand. The depth of the Phase I borings was not adequate to determine the depth of the alluvial clay layer that underlies the silty sand. A thin surface layer of 1.8 ft of sandy silt was encountered at Boring 3179. Representative boring logs taken from Borings 3176 and 3178 are presented in Figures 36-3-2 and 36-3-3.

1.3 HYDROLOGY

Site 36-3 is in the Basin A surface drainage on the southeastern edge at an elevation of approximately 5,250 ft msl. Surface drainage is to the northwest through Basin A (Figure 36-3-4).

The general direction of ground water flow at RMA is northwest. Within Section 36, the flow varies from northeast to west due to local bedrock influences. Ground water flow beneath this site is to the north. The ground water contour map generated from water levels in March 1986 (ESE, 1986b, RIC#86238R08) indicates that the water table elevation ranges from 5,237 to 5,239 ft msl at the site or approximately 11 to 13 feet below the surface (Figure 36-3-5).

Six Phase I borings penetrated to the water table. Borings 3175, 3176, 3177, 3178, 3179, and 3180 encountered ground water at depths of 4.0, 9.0, 5.0, 6.0, 4.0, and 4.0 ft, respectively. Using the top of boring elevations and these depths to water, the elevations of ground water (to the nearest 0.5 ft) in the six borings are as follows: 5242.0, 5241.0, 5243.0, 5245.0, 5242.0, and 5242.5 ft msl. The water table configuration is in general agreement with the historical ground water contour maps

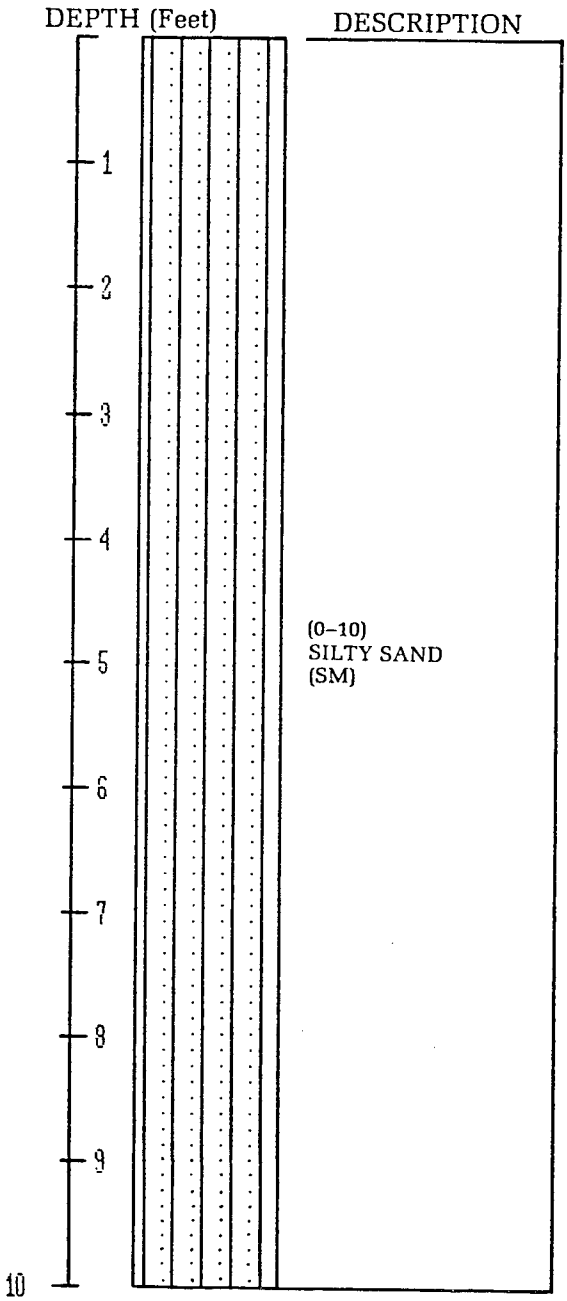

Figure 36-3-2
FIELD BORING PROFILE FOR BORING 3176

SOURCE: ESE, 1987

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For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

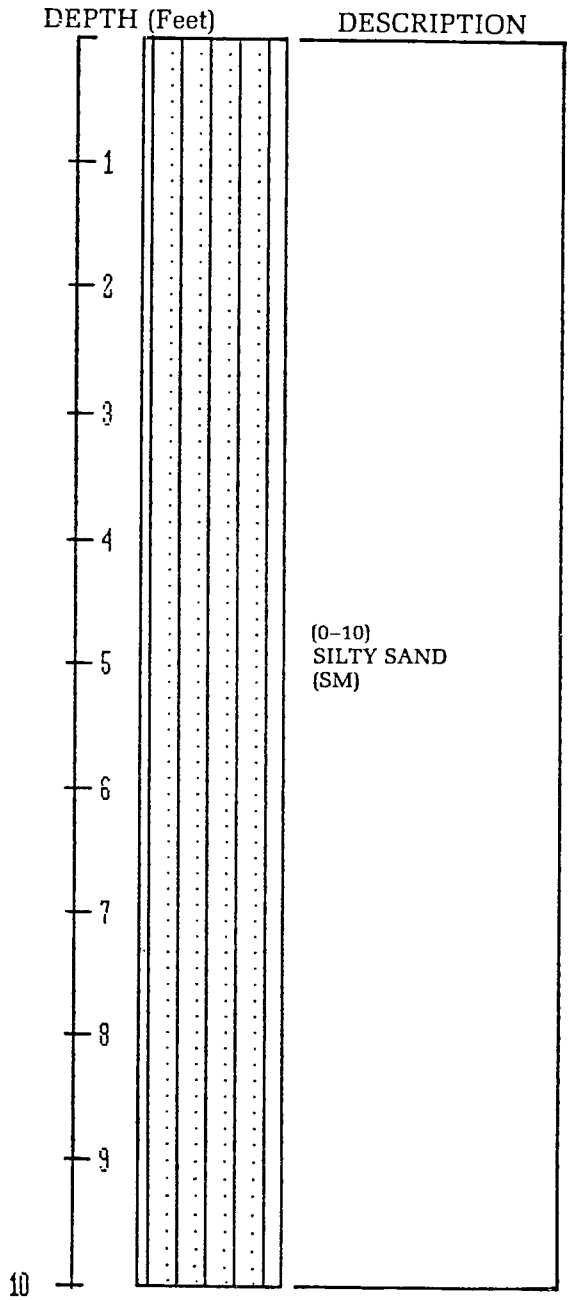

Figure 36-3-3
FIELD BORING PROFILE FOR BORING 3178

SOURCE: ESE, 1987

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Aberdeen Proving Ground, Maryland

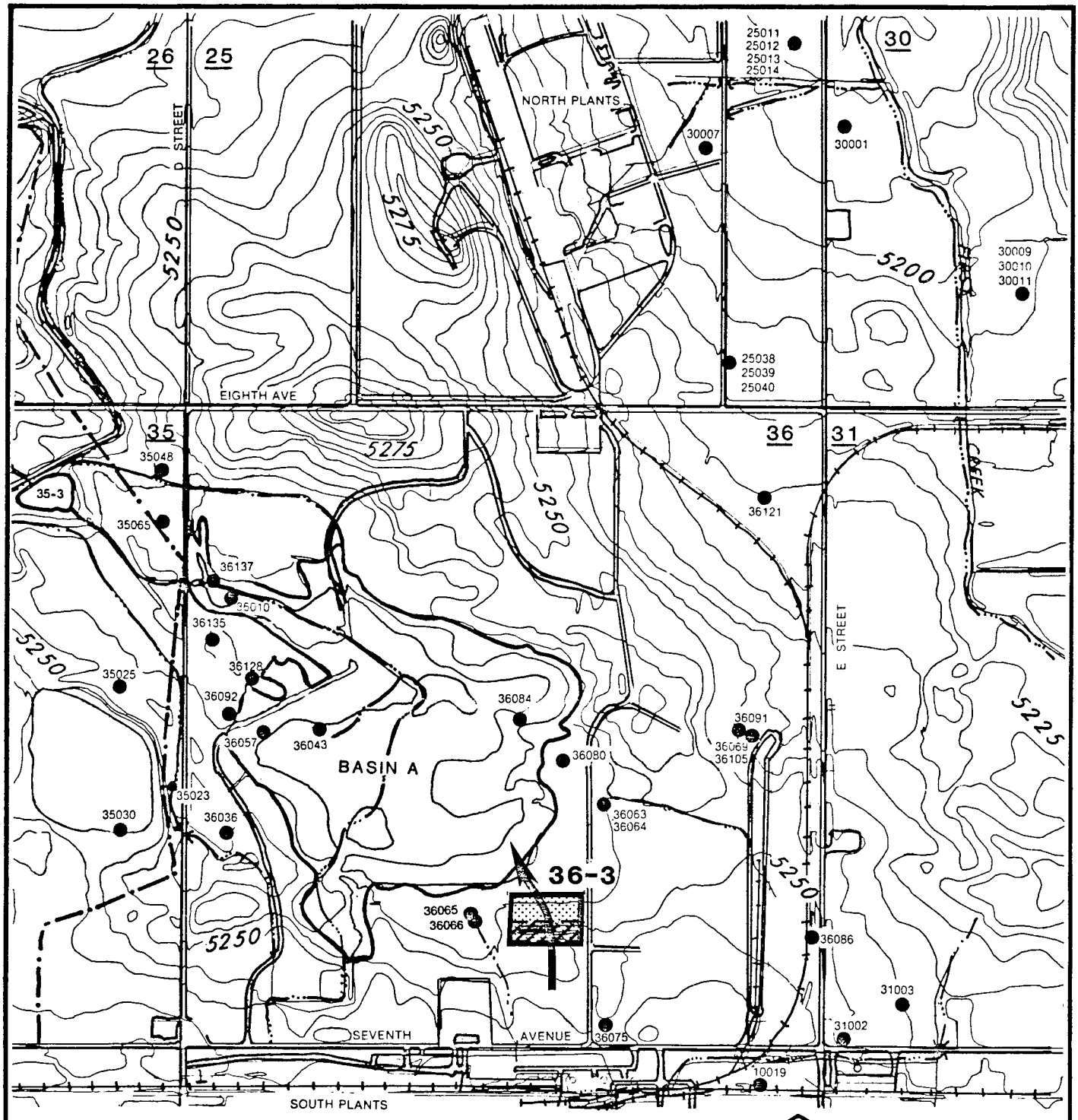

Figure 36-3-4
REGIONAL TOPOGRAPHY
SITE 36-3
ROCKY MOUNTAIN ARSENAL
SOURCE: ESE, 1986

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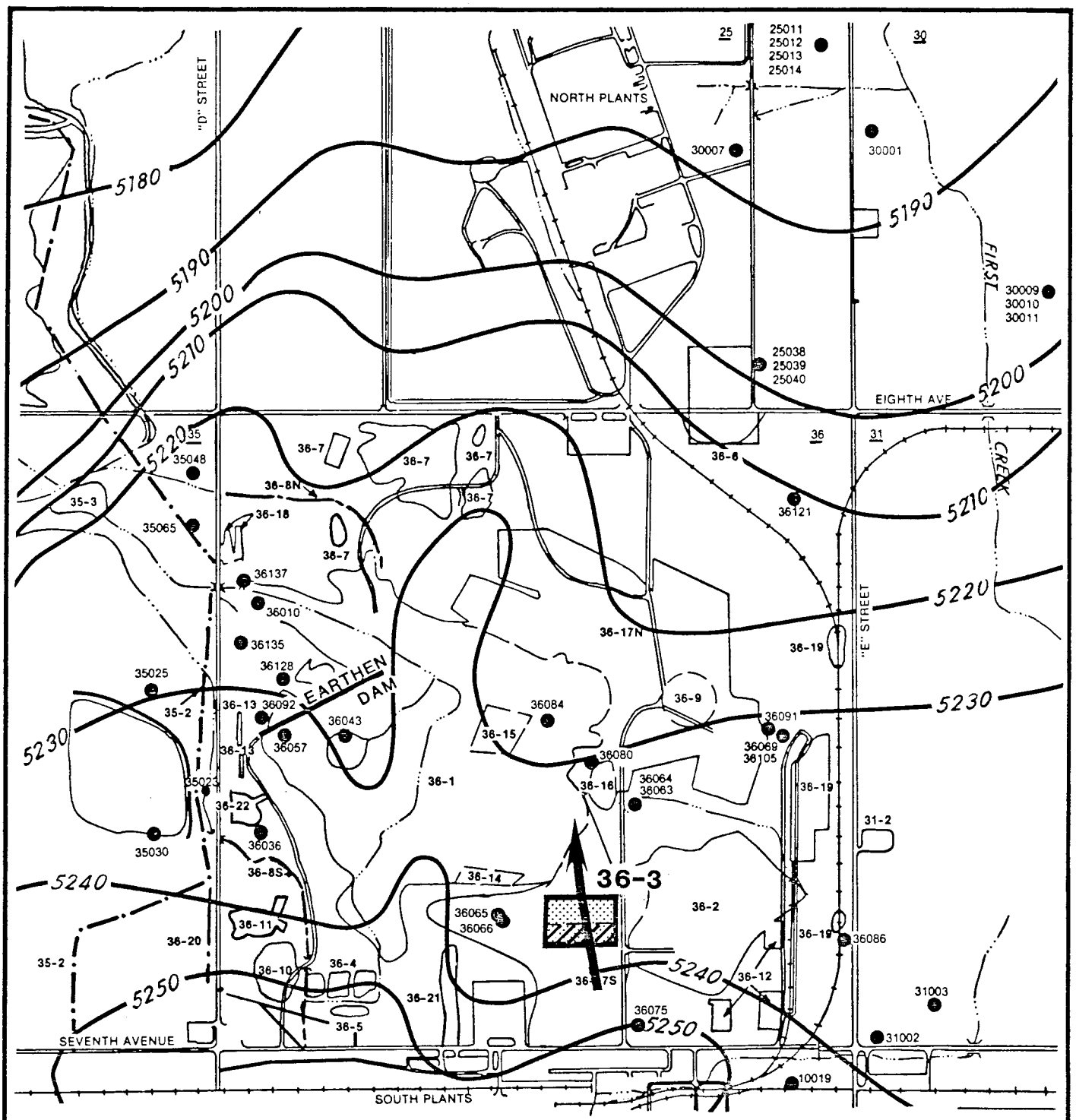
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland



EXPLANATION

- Monitoring Wells
- Investigated Site
- Creek
- RMACCPMT Site Location (1984, RIC No.84034R01)
- Sewer Line
- Water Table Elevation Contour
- Ground Water Flow

N

1200 0 1200

APPROXIMATE SCALE (in feet)
Contour Interval 10 Feet

Figure 36-3-5
REGIONAL GROUND WATER FLOW,
SITE 36-3
ROCKY MOUNTAIN ARSENAL
SOURCE: ESE,1986

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

presented in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Depths to water are about 5 to 10 ft shallower than anticipated; however, these elevations correlate with the data collected in Task 4.

Historical data were retrieved from the USATHAMA-RMA database and reviewed. Data collected for Well 36075 upgradient of the site revealed previous detections of dieldrin, isodrin, dibromochloropropane (DBCP), diisopropylmethyl phosphonate (DIMP), p-chlorophenylmethyl sulfone ($CPMSO_2$), chloroform, and benzene. However, this same well (36075), when analyzed in the more recent Task 4 screening program, showed no detections of any target analytes (ESE, 1986b, RIC#86238R08). Historically, detections of organochlorine pesticides, organosulfur compounds, as well as some of the target volatile organic compounds, DBCP and DIMP among others, have occurred downgradient of this site in wells which are not included in the Task 4 program due to poor construction. Recent Task 4 data for alluvial or Denver wells in the vicinity of the site (36065, 36066) (Figure 36-3-5) show detections of DBCP, chloroform, carbon tetrachloride (CCL_4), and trichloroethene (TRCLE). The presence of several volatile organic compounds in ground water samples from the Site 36-3 vicinity and the apparent increase in downgradient ground water concentrations of other volatiles suggest that these contaminants may be derived in part from Site 36-3. These compounds are indicative of compounds found in ground water in the Basin A/South Plants Area. There is not enough data to determine the relative contribution this site may have on the overall water quality with respect to other contributing sites in the area. More detailed information can be found in the Task 4 Initial Screening Program Report (ESE, 1986b, RIC#86238R08).

2.0 HISTORY

This area was reportedly used as a trenching/disposal site beginning in 1953. Pesticide and Army wastes were reportedly deposited in these trenches (Moloney, 1982, RIC#85085R01). Trenches were dug as needed, with an east-west direction predominating, to a depth of 6 to 10 ft. Aerial photographs of Site 36-3 (HLA, 1986a, RIC#86314P02; Moloney, 1982, RIC#85085R01; Stout et al., 1982, RIC#83368R01) have been summarized as follows:

Photograph Date	Description
1948	No evidence of this site.
1950	No evidence of this site.
1953	A new, carefully prepared site is apparent and consists of one long trench and one small one immediately north of it.
1958	Four to eight trenches have been added to the central portion of the site.
1962	An additional 8 to 12 trenches now exist north and south of those previously in place. In addition, a single trench extending from the southeast to the northwest appears north of the original site boundary. A total of 15 trenches now exist at this site.
1975	Ten new trenches and four pits to the north of the original site boundary appear. On the southern side a large area has been scraped clear and five trenches and four pits exist in the area. A drainage ditch at the northwest corner drains into Basin A.

3.0 SITE INVESTIGATION

3.1 PREVIOUS SOIL INVESTIGATIONS

Site 36-3 is in the south-central portion of Section 36. Soil in the area belongs to the Ascalon-Vona-Truckton Association and is defined as nearly level to strongly sloping, well-drained to excessively-drained, loamy and sandy soil. This soil becomes clay rich and calcareous with depth (Sampson and Baber, 1974). No previous soil contamination studies are documented for this site.

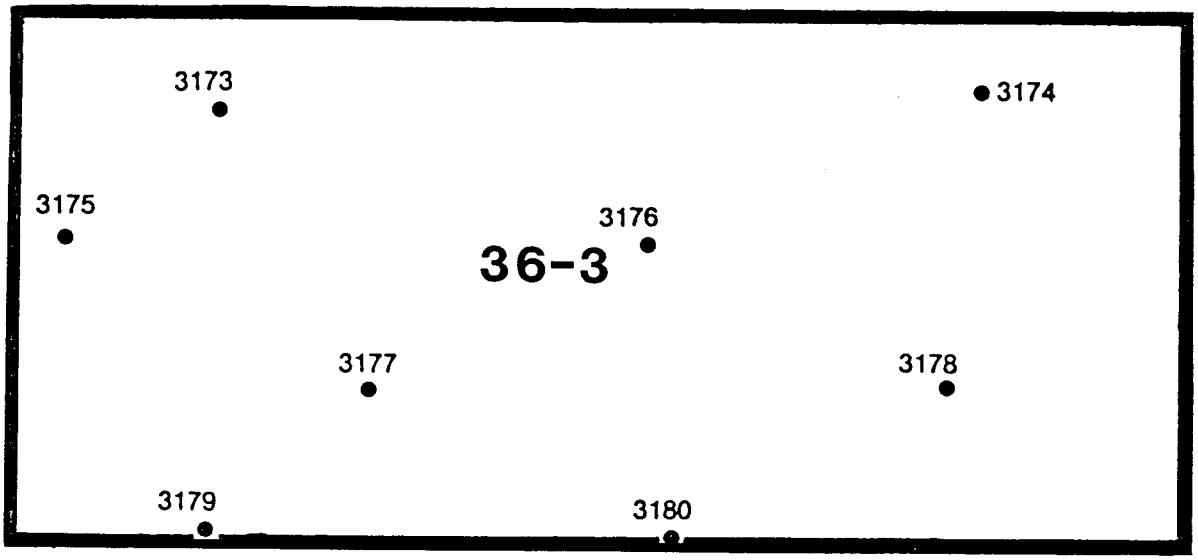
3.2 PHASE I SURVEY

3.2.1 Phase I Program

Based on an areal extent of 230,000 ft^2, the Phase I investigation consisted of eight borings. These borings were arranged in a grid pattern as shown in Figure 36-3-6. Borings ranged in depth from 3 to 10 ft. The site boundaries shown in Figure 36-3-6 differ from those presented in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07) as a result of modifications made following field reconnaissance and aerial photograph interpretations to better locate sample points with respect to the actual landfill area.

The sampling program at Site 36-3 included collection of 16 samples. Samples were obtained using the continuous soil sampling method described in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Samples were obtained at predetermined intervals unless field conditions [i.e., water table, staining, high photoionization detector (PID) values, etc.] required an adjustment in the intervals. Eight borings yielding 16 samples were completed in Site 36-3 as follows:

Boring No.	Depth (ft)	No. of Samples
3173	5	2
3174	1	1
3175	5	2
3176	10	3
3177	5	2
3178	10	3
3179	5	2
3180	5	1
		17



36-17S

EXPLANATION

3139 ● Phase I Boring

N

0 100 200 300 feet

SCALE

Figure 36-3-6
PHASE I INVESTIGATION,
BORING LOCATION MAP,
SITE 36-3
SOURCE: ESE, 1985

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

Prior to drilling, all boring sites were cleared for safety purposes in accordance with the geophysical program detailed in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Borehole site clearance was used to ensure drilling would not encounter buried unexploded ordnance (UXO) or other metal that could pose a significant safety risk. Magnetic intensity readings were obtained with a gradiometer. A 20-ft-square grid was centered at each boring location, and gradiometer readings were obtained at a spacing of 5 ft throughout the area. A contour map was prepared from the data and used to place the boring in the safest location within the geophysical plot. Following borehole site clearance, a metal detector was used to check for surficial (0 to 2 ft) metal which may have presented a safety risk. This procedure should not be confused with the geophysical exploration program outlined in Section 3.2.3 of this report.

On the basis of the geophysics program results, three borings (3176, 3178, 3179) had to be relocated due to possible buried metal. The contour plots of these borings all exhibited anomalies indicative of buried metal. The contour plots for Borings 3173, 3174, and 3180 also exhibited anomalies representative of potential buried metal, although these anomalies were positioned in a manner that did not require relocation of the borings. An anomaly present in the northwest corner of Boring 3173 grid was indicative of a large buried metal object relatively close to the surface. Metal detector scans of all boring locations in this site were negative for shallow (0 to 2 ft) metal.

A PID, calibrated to an isobutylene standard, was used to obtain readings from open boreholes during drilling and from soil samples during geologic logging. The PID measures the concentrations of organic vapors in the air and is a method of ensuring personnel safety.

All samples were analyzed by gas chromatography/mass spectrometry (GC/MS) for semivolatile organic compounds, and by inductively coupled argon

plasma (ICP) analyses for cadmium, chromium, copper, lead, and zinc. Separate analyses were conducted for mercury and arsenic by atomic absorption (AA) spectroscopy and for DBCP by GC. GC/MS volatile organic analyses were performed on the deepest sample intervals from Borings 3176 and 3178. A complete list of Phase I analytes is in Appendix 36-3-A.

3.2.2 Phase I Field Observations

Site 36-3 lies in a relatively flat area, dipping very slightly to the northwest. Vegetation is sparse, particularly along the southern edge of the site. Strong physical evidence exists of past disturbances and disposal. The following observations were made while drilling at Site 36-3:

- Boring 3174 was halted at a depth of 3 ft when a large impenetrable object was encountered. Areas within 5 ft of the drill rig were noticeably shaken when the auger hit the object.
- Trench debris was encountered at Boring 3178, including rubber gloves, cardboard, and paper. Sampling at this boring indicated that the depth to the bottom of the trench was approximately 9 ft.
- Visual signs of soil staining were observed on samples taken at 3 ft in Boring 3174 and 4 ft in Boring 3178.
- The water table was encountered by six borings (3175, 3176, 3177, 3178, 3179, and 3180) at depths ranging from 4.0 to 9.0 ft below the surface.
- Air monitoring activities detected the presence of contaminants in the breathing zone at a reading of 0.8 (Boring 3176). Readings taken in the hollow stem auger indicated readings of 1 to 60.
- Air monitoring at the remainder of the boreholes did not detect contaminants in the breathing zone; however, readings from down-hole were as much as 1 to 40.

An M8 Alarm and M18A2 test kit were used to detect the presence of chemical agents in the boreholes and soil samples. The M8 alarm is used to detect Sarin (GB) and VX at detection levels of 0.2 and 0.4 milligrams per cubic meter (mg/m^3), respectively, after a response time of 2 to 3 minutes (USAMDARC, 1982; USAMDARC, 1979). However, many other

substances, including smoke and engine exhaust, can activate the M8 alarm.

The M18A2 is used as a backup test if the M8 alarm is triggered, as a substitute for the M8, and as a specific check for the presence of mustard. The M18A2 detects G agents [including tabun (GA), GB, and Soman (GD)]; V agents; all forms of mustard [mustard (H), distilled mustard (HD), thickened mustard (HT); and nitrogen mustard (HN)]; cyanogen chloride (CK); phosgene oxime (CX); Lewisite (L); ethyldichloroarsine (ED); and methyldichloroarsine (MD) (HDOA, 1976). The detection limit for mustard agents is 0.5 mg/m^3; the detection limit for GB is 0.2 mg/m^3.

The strong physical evidence at this site corroborates the reported disposal history. The site is marked by east-west trending linear mounds indicative of disposal trenches. In addition, the northern boundary of this site is characterized by a 4- to 5-ft slope not typical of surrounding topography. Differential settlement of the trench materials is indicated by localized depressed or caved areas at the site. Signs of debris (paper, wood products, glass) are also on the surface of the site. Indications of vegetative stress occur along the southern site boundary.

3.2.3 Geophysical Exploration

Due to the nature of disposal practices (trenching) at Site 36-3, it was anticipated that the borings would not show a similar array of target compounds or a similar pattern of occurrence. These hypotheses were confirmed by Phase I chemical results. To provide additional information on the extent of potential contamination at Site 36-3 and to provide guidance for the Phase II soil investigation, a comprehensive geophysical program was conducted at this site following the Phase I drilling program.

Ground penetrating radar (GPR), magnetometer, electromagnetic (EM) techniques, and vertical electrical soundings (VES) were used to define the orientation and dimensions of the historical disposal trenches.

The magnetometer survey included the installation of a self-recording base station approximately 2,000 ft south of Site 36-3. The base station

data are used to correct survey data for artifacts that may arise from magnetic activity in the ionosphere. Base station data are also used to compute the total intensity of the ambient magnetic field at the site. The magnetometer records measurements of the earth's magnetic field and is affected strongly by the presence of buried ferrous metal. The magnetometer survey pattern consisted of 151, 350-foot-long, north-south traverses of the site spaced 5 ft apart starting on the west side. Magnetometer data were collected along every other line from line 2 to line 140 and then every line from line 141 to 150.

EM techniques were used to determine ground conductivity. EM measurements are affected by both ferrous and non-ferrous metal. Measurements were made along each of the 151 north-south traverses of the site. EM techniques were the primary method used to define areas of trenching.

GPR, an electromagnetic profiling system with a high powered transmitter, was used to search for trench boundaries and buried metal objects. Due to high soil conductivities, GPR was largely ineffective, so its use was discontinued after a testing program.

VES is an effective method for defining electrical soil stratigraphy. This geophysical investigation included 13 VES soundings in the Site 36-3 area.

More detailed information regarding these geophysical investigations is presented in the draft report Geophysical Investigation of Contaminant Sources 36-3, 36-10, and 36-17 (HLA, 1986b; RIC#86353R01).

Portions of trenches were assigned an appropriate level of confidence, based on the correlation of EM and magnetometer readings. The geophysical survey at Site 36-3 resulted in the identification of 31 potential trench locations with widths of 8 to 22 ft and lengths of 40 to 660 ft.

3.2.4 Phase I Analyte Levels and Distribution

Analytes anticipated to be present at Site 36-3 included numerous compounds associated with pesticide and insecticide manufacturing activities in the South Plants Area. These compounds include a variety of organochlorine and organophosphorous compounds, as well as raw materials and by-products associated with their synthesis.

Phase I analytical data for Site 36-3 are tabulated in Appendix 36-3-B. A descriptive summary of these results is presented in Table 36-3-1. A listing of samples containing detectable concentrations is provided in Table 36-3-2; and values within and above indicator ranges are presented in Figure 36-3-7.

To assess the significance of metal and organic analytical values, indicator ranges were established. For organic compounds, the indicator level is the method detection limit. For metals, a range of values was chosen to reflect the upper end of the natural range for each metal as normally found in RMA alluvial soil. The procedure for establishing indicator ranges is presented in the Introduction to the Contamination Assessment Reports (ESE, 1986a).

Phase I analytical results for Site 36-3 are consistent with the disposal history for this area. Each of the eight borings contained detectable concentrations of one or more organochlorine pesticides, including aldrin, dieldrin, endrin, and isodrin. Dieldrin is the most frequently observed organochlorine pesticide and the only one detected in five of the seven surface samples containing organic compounds. Concentrations ranged from 0.4 to 20 ppm in these samples. DBCP was observed in samples from four borings. The organosulfur compounds chlorophenylmethyl sulfide (CPMS), chlorophenylmethyl sulfoxide (CPMSO), and chlorophenylmethyl sulfone ($CPMSO_2$) were detected in Boring 3179, and dicyclopentadiene (DCPD) was also observed in only one boring (3176). Volatile organic compounds were analyzed in samples collected from the deepest intervals of Borings 3176 and 3178. One of these samples contained detectable concentrations of chloroform ($CHCL_3$, 2 ppm), methylene chloride (CH_2CL_2, 1 ppm), tetrachloroethene (TLCEE, 0.6 ppm), toluene (8 ppm), and benzene

Table 36-3-1. Summary of Analytical Results for Site 36-3 (Page 1 of 2)

Constituent	Number of Samples*	Concentrations (µg/g) Range	Mean	Median	Standard Deviation	ESE Detection Limit	MRI Detection Limit	Indicator Range
Volatiles (N=2)†								
$CHCL_3$	1	2	--	--	--	0.3	0.7	DL
BCHD	1	1	--	--	--	0.3	0.8	DL
CH_2CL_2	1	1	--	--	--	0.3	NC	DL
TCLEE	1	0.6	--	--	--	0.3	0.5	DL
Benzene	1	0.9	--	--	--	0.3	1.0	DL
Toluene	1	8	--	--	--	0.3	0.3	DL
Semivolatiles (N=16)†								
Aldrin	4	1-100	--	--	--	0.9	0.5	DL
Dieldrin	10	0.4-20	5	3	6	0.3	0.6	DL
Endrin	5	2-10	6	3	4	0.7	4.0	DL
Isodrin	4	0.5-20	--	--	--	0.3	0.6	DL
DCPD	1	20	--	--	--	0.3	0.3	DL
CPMS	1	2	--	--	--	0.3	0.3	DL
CPMSO	2	1-2	--	--	--	0.4	1.0	DL
$CPMSO_2$	1	20	--	--	--	0.3	0.4	DL
DBCP (N=16)†	6	0.009-2.2	0.62	0.19	0.87	0.005	0.005	DL
Metals (N=16)†								
Cadmium	7	1.0-3.5	5.0	1.1	0.91	0.90	0.50	1.0-2.0
Chromium	13	9-21	13	12	3.3	7.2	7.4	25-40
Copper	13	6-29	9.8	8.0	6.0	4.8	4.9	20-35
Lead	8	17-68	29	21	17	17	16	25-40
Zinc	16	16-65	38	36	13	16	28	60-80
Arsenic (N=16)†	5	4.9-5.3	5.1	5.1	0.14	4.7	5.2	DL-10
Mercury (N=16)†	10	0.060-0.45	0.16	0.080	0.16	0.050	0.070	DL-0.10

* Number of samples in which constituent was detected above detection limit.
† N= Number of samples analyzed.
-- Not calculated for less than five detections.
DL Detection limit.
NC Not certified for CH_2CL_2.

Source: ESE, 1987.

Table 36-3-2. Concentrations of Target Analytes Above Detection Limits in Site 36-3 Soil Samples (Page 1 of 2)

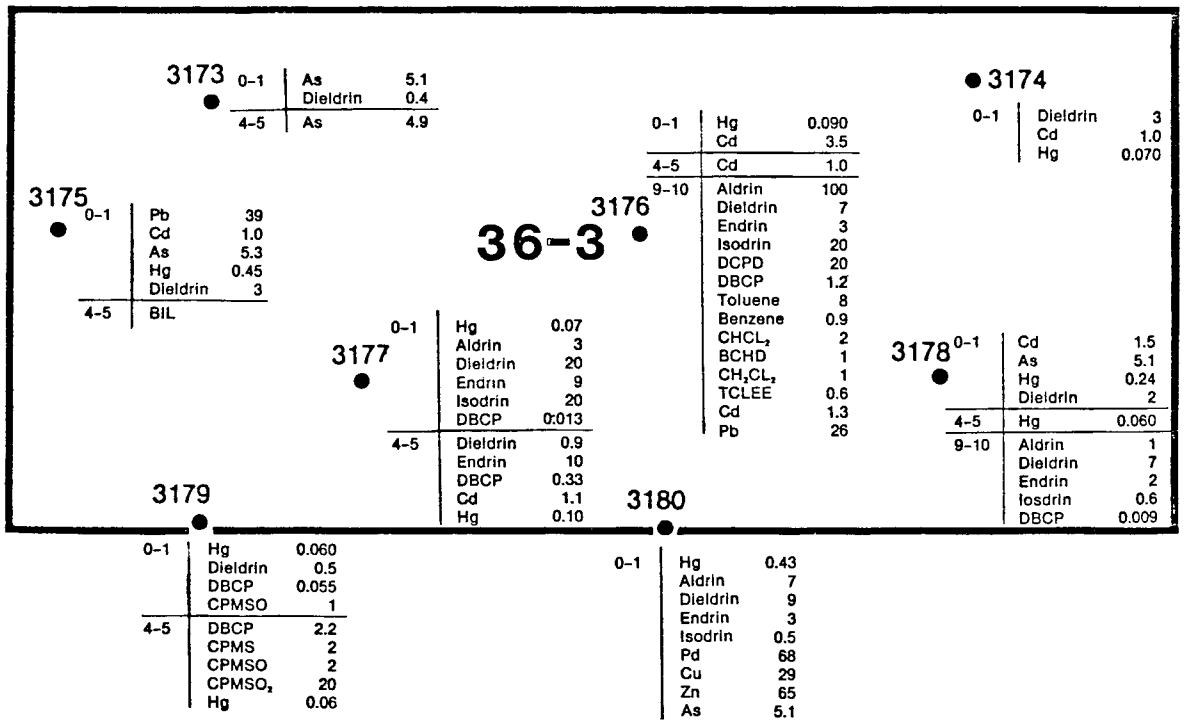
Bore Number	3173	3173	3174	3175	3175	3176	3176	3176
Depth (ft)	0-1	4-5	0-1	0-1	4-5	0-1	4-5	9-10
Geologic Material	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Saturated Silty Sand	Silty Sand	Silty Sand	Silty Sand
AIR MONITORING								
PID*	BKD	BKD	BKD	10	1.0	1.5	3.2	7.0
SOIL CHEMISTRY								
Volatiles (µg/g)								
$CHCL_3$	NA	NA	NA	NA	NA	NA	NA	2
BCHD	NA	NA	NA	NA	NA	NA	NA	1
CH_2CL_2	NA	NA	NA	NA	NA	NA	NA	1
TCLEE	NA	NA	NA	NA	NA	NA	NA	0.6
Benzene	NA	NA	NA	NA	NA	NA	NA	0.9
Semivolatiles (µg/g)								
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	100
Dieldrin	0.4	BDL	3	3	BDL	BDL	BDL	7
Endrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3
Isodrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20
CPMS	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CPMSO	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
$CPMSO_2$	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
DCPD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20
DBCP (µg/g)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.2
Metals (µg/g)								
Cadmium	BDL	BDL	1.0	1.0	BDL	3.5	1.0	1.3
Chromium	12	16	10	12	BDL	11	9.0	BDL
Copper	8.0	9.0	8.0	10	BDL	7.0	6.0	BDL
Lead	BDL	18	BDL	39	BDL	BDL	BDL	26
Zinc	36	43	34	43	20	36	27	20
Arsenic (µg/g)	5.1	4.9	BDL	5.3	BDL	BDL	BDL	BDL
Mercury (µg/g)	BDL	BDL	0.070	0.45	BDL	0.090	BDL	BDL

Table 36-3-2. Concentrations of Target Analytes Above Detection Limits in Section 36-3 Soil Samples (Continued, Page 2 of 2)

Bore Number	3177	3177	3178	3178	3178	3179	3179	3180
Depth (ft)	0-1	4-5	0-1	4-5	9-10	0-1	3-4	0-1
Geologic Material	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silty Sand	Silt	Silty Sand	Silty Sand
AIR MONITORING								
PID*	0.8	BKD	0.6	35	2.0	1.6	BKD	
SOIL CHEMISTRY								
Volatiles (µg/g)								
	NA	NA	NA	NA	BDL	NA	NA	NA
Semivolatiles (µg/g)								
Aldrin	3	BDL	BDL	BDL	1	BDL	BDL	7
Dieldrin	20	0.9	2	BDL	7	0.5	BDL	9
Endrin	9	10	BDL	BDL	2	BDL	BDL	3
Isodrin	20	BDL	BDL	BDL	0.6	BDL	BDL	0.5
CPMS	BDL	BDL	BDL	BDL	BDL	BDL	2	BDL
CPMSO	BDL	BDL	BDL	BDL	BDL	1	2	BDL
$CPMSO_2$	BDL	BDL	BDL	BDL	BDL	BDL	20	BDL
DCPD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
DBCP (µg/g)	0.013	0.33	BDL	BDL	0.009	0.055	2.2	BDL
Metals (µg/g)								
Cadmium	BDL	1.1	1.5	BDL	BDL	BDL	BDL	BDL
Chromium	10	BDL	12	16	10	14	14	21
Copper	7.0	BDL	8.0	10	6.0	11	8.0	29
Lead	BDL	BDL	20	19	BDL	22	17	68
Zinc	37	16	41	54	36	54	47	65
Arsenic (µg/g)	BDL	BDL	5.1	BDL	BDL	BDL	BDL	5.1
Mercury (µg/g)	0.070	0.10	0.24	0.060	BDL	0.060	0.060	0.43

BDL Below Detection Limit.
BKD No reading above ambient background.
* As calibrated to an isobutylene standard.
NA Not analyzed.

Source: ESE, 1987.



36-17S

EXPLANATION

3173 Phase I Boring

Analyte

Sampling Interval → 0-1 As 5.1 Dieldrin 0.4 ← Level(ug/g)

4-5 As 4.9

Bedrock Sample →

BIL No Organics Above Detection Limits; No Metals ≥ Indicator Levels

N

0 100 200 300 feet

SCALE

Figure 36-3-7
PHASE I INVESTIGATION, CHEMICAL ANALYSIS RESULTS, SITE 36-3

SOURCE: ESE, 1987

Prepared for:
U.S. Army Program Manager's Office For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

(0.9 ppm). The other sample had no detectable volatile analytes. Bicycloheptadiene (BCHD), a pesticide precursor, was observed in the sample containing volatile organic compounds at a concentration of 1 ppm.

Arsenic was present in Borings 3173, 3175, 3178, and 3180. With the exception of Boring 3173, all of these detections occurred in the 0- to 1-ft interval. All of the concentrations are within the indicator range and range from 4.9 to 5.3 ppm. Mercury was detected in 10 of the 16 samples. Seven of the concentrations were within the indicator range and three exceeded it. Six concentrations of cadmium were within the indicator range and one exceeded the range. Copper and zinc were found within their respective indicator ranges only in Boring 3180. Lead concentrations were within the indicator range in Boring 3175 (39 ppm) and Boring 3176 (26 ppm). The lead concentration (68 ppm) in Boring 3180 exceeded the indicator range. Appendix 36-3-A includes a list of target compounds and their associated abbreviations.

Several compounds were detected by GC/MS that were not included in the target compound list and that were not conclusively identified. These compounds are included in the data presented in Appendix 36-3-B. Table 36-3-3 lists the boring number, sample interval depth, relative retention time (shown as "unknown number" on the table), concentration, sample number, lot, best-fit identification, and comments for these nontarget compounds detected at Site 36-3. It should be noted that an individual compound may have more than one retention time and that a particular retention time may be assigned to more than one compound. Therefore, Table 36-3-3 provides only a general indication of additional compounds that may be present.

Sixteen samples were analyzed for nontarget compounds using the GC/MS screening technique. Seven of these samples did not contain any nontarget compounds above the established criteria. Five of the remaining samples contained chlorinated organics in concentrations that ranged from 1 to 10 ppm. These included hexachlorobenzene, pentachloro (trichloroethenyl) benzene, chlordene, and endrin ketone.

Table 36-3-3. Tentative Identification of Nontarget Compounds (Page 1 of 2)

Borehole Number	Interval Depth (ft)	Unknown Number	Concentration Above Background (ppm)*	Sample Number	Lot	Best Fit	Comments†
3173	0-1	535	1	509700	BAP	Unknown	a
		554	0.6			Unknown	a
		596	6			Hexachlorobenzene	
		614	3			Pentachloro(trichloroethenyl) benzene	
		629	1			Unknown	a
	4-5	585	0.9	509701	BAP	Unknown	a
3174	0-1	535	1	509706	BAP	Trichloropropene	
		591	5			Unknown	a
		596	9			Hexachlorobenzene	
		614	4			Pentachloro(trichloroethenyl) benzene	
3175	0-1			509712	BAP		i
	4-5			509713	BAP		i
3176	0-1			509718	BAP		j
	4-5			509719	BAP		i
	9-10	551	8	509720	BAP	o,o-Diethyl-o-methyl phosphorothioate	
		577	10			Unknown	a
		580	20			Pentadecane	g
		629	8			Unknown	a
		631	8			Endrin ketone	
3177	0-1	618	4	509724	BAQ	Unknown	a
		625	2			Isodrin (Target found)	
		630	4			Unknown	a
		633	10			Endrin ketone	
		635	2			Unknown	a
	4-5	561	0.8	509725	BAQ	Unknown	a
3178	0-1			509730	BAP		i
	4-5			509731	BAP		i

Table 36-3-3. Tentative Identification of Nontarget Compounds (Page 2 of 2)

Borehole Number	Interval Depth (ft)	Unknown Number	Concentration Above Background (ppm)*	Sample Number	Lot	Best Fit	Comments†
3178	9-10	581	2	509732	BAP	Unknown	a
		630	50			Dioctyladipate	c
3179	0-1			509736	BAQ		j
	3-4	522	0.8	509737	BAQ	4-hydroxy-4-methyl-2-pentanone	
		547	2			2-hydroxy-1-phenyl-ethanone	
		593	0.9			Unknown	a
		603	0.3			Unknown	a
		616	0.6			Unknown	a
3180	0-1	601	3	509742	BAQ	Chlordene	
		603	0.8			Unknown	a
		619	1			Endo, exo, endo-octahydro-dimethane-benze (f) indene	

* Values reported are method blank corrected.

† a. No positive identification.
b. Surfactant.
c. Plasticizer (note: All phthalates and adipates will have this comment).
d. Derived from natural products.
e. Suspected laboratory contaminant.
f. Low concentration.
g. Low frequency of occurrence.
h. Ubiquitous.
i. Possible column bleed.
j. None detected.

Source: ESE, 1987.

3.2.5 Phase I Contamination Assessment

The relationship between deep and shallow soil concentrations of analytes in Site 36-3 is unclear based on the present sample distribution. No clear trends in areal or vertical distribution are evident. Of the numerous compounds observed in samples from Site 36-3, organochlorine pesticides and DBCP are the most prevalent. These compounds are widely distributed, occurring in seven 0- to 1-ft sample intervals as well as two 4- to 5-ft and two 9- to 10-ft interval samples. One boring contained target analytes only in the surface sample; the remaining five borings which penetrated beyond the 0- to 1-ft interval exhibited concentrations of analytes in the deeper intervals. Similarly, relatively elevated concentrations of DCPD, BCHD, and the organosulfur compounds occurred in the deeper sampling intervals. Inorganic constituents were at concentrations above the indicator ranges only in surface interval samples; their areal distribution appears sporadic. Disposal of wastes in discrete trenches, followed by subsequent closure and reworking of surface soils, could result in the observed variability of concentrations with depth.

Five of the borings contained chlorinated nontarget analytes in significant concentrations (3173, 0 to 1 ft; 3174, 0 to 1 ft; 3176, 9 to 10 ft; 3177, 0 to 1 ft; 3180, 0 to 1 ft). The compounds, hexachlorobenzene, pentachloro (trichloroethenyl) benzene, chlordene, and endrin ketone, all appear to be associated with the target organochlorine pesticides. Therefore, it is felt that the proposed Phase II sampling and analysis program will adequately address the definition of the vertical and aereal extent of these type contaminants.

Results of the geopyhysical investigation and Phase I boring program at this site confirm that wastes were disposed in trenches and pits.

Excellent correlation was observed between the results of the geophysical investigation and both field observations and soil quality analyses. For example, Boring 3178 was shown by the geophysical investigation to be through a trench where moderate data confidence was observed. The soil boring penetrated debris and laboratory wastes to depths of about 9 ft. In Boring 3174 an impenetrable object was encountered, and geophysical

investigation showed this boring to be through a trench. Borehole 3175 did not encounter trench material nor were any elevated concentrations of target analytes detected. The results of the geophysical investigation showed this borehole to be through inter-trench material.

The apparent increase of volatile organic compounds in ground water samples downgradient of the site, as well as the detection of the moderately volatile pesticide DBCP in soil samples may be an indication that volatile organic compounds are present in the unsaturated zone of Site 36-3. Organochlorine pesticides, which occur at higher concentrations than volatile organic compounds in soil samples are observed only sporadically in ground water samples. The absence of uniformly high concentrations of organochlorine pesticides in ground water is most likely due to their low solubility and high affinity for soil organic carbon.

3.3 PHASE II SURVEY

On the basis of Phase I analytical and geophysical data, the site boundary has been slightly enlarged at the northwest corner to include an area of additional geophysical anomalies. Although analytes were detected in soil near the site boundaries, adjacent areas are considered part of Site 36-17. The proposed Phase II program is designed to obtain soil quality data from outside the defined site boundary as well as for soil inside the boundary. Final revisions to the Site 36-3 boundary will be made upon conclusion of the Phase II investigations.

A revised Phase II program is recommended on the basis of the soil boring results and geophysical programs at Site 36-3. Objectives of this Phase II program are both to define the outer extent of possible soil contamination resulting from trench disposal practices and to confirm the accuracy of the geophysical investigation in identifying the orientation and dimensions of the disposal trenches.

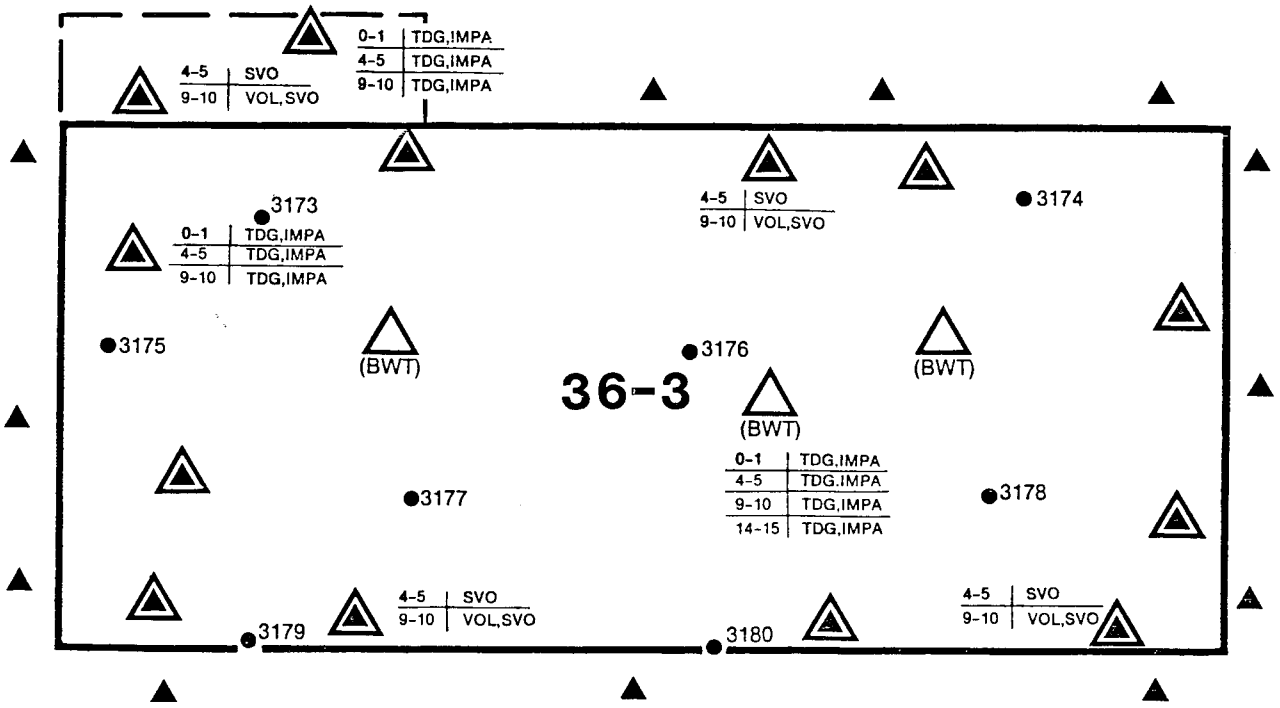
The first of these objectives will entail the construction of 20 soil borings to various depths in locations along the perimeter of the trenched area defined by the geophysical investigation as shown in

Figure 36-3-8. Twelve of these boreholes will be drilled outside the current site boundary to a depth of 5 ft to define the extent of potential contamination resulting from surface grading or wind dispersion. The Phase I investigation showed that measurable concentrations of analytes were present in near-surface soil outside the trenched areas. The remaining boreholes outside the trenched area will be drilled to 10 ft to confirm the lack of disposal trenches in specific locations which fall within the Site 36-3 boundary. Specifically, significant areas on the eastern side and the southwest corner of Site 36-3 appear not to contain disposal trenches.

The remainder of the Phase II soil boring program will include the construction of boreholes in locations identified by the geophysical investigation as containing disposal trenches. These boreholes will confirm the presence of trenches, ground truth the geophysical methods, and determine the maximum depth of historical trenching activities. These additional boreholes will use information from Phase I boreholes to estimate the maximum depth of trenching activities and the extent of vertical soil contamination. Each of these boreholes will be constructed to depths greater than the static water table and will proceed at least to the maximum depth of trenching. Three of the Phase II boreholes will be drilled to 15 ft, which is approximately 7 to 10 ft beneath the water table contact. The remaining Phase II boreholes in the central portion of the site will be drilled to 10 ft. A summary of the Phase II boring program is listed below:

Number of Borings	Depth (ft)	Number of Samples
12	5	24
13	10	39
3	15 (water table)	12
TOTAL 28		75

The sampling intervals have been designated as 0 to 1, 4 to 5, and 9 to 10 ft, but adjustment of the intervals and the addition of more samples will be determined in the field at the discretion of the site geologist.



LEGEND

▲	0-1	OCP,OPP,OSC,DBCP,DCPD,HG
	4-5	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO
▲	0-1	OCP,OPP,OSC,DBCP,DCPD,HG
	4-5	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO
	9-10	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO
△	0-1	OCP,OPP,OSC,DBCP,DCPD,HG
	4-5	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO,VOL,SVO
	9-10	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO,VOL,SVO
	14-15	OCP,OPP,OSC,DBCP,DCPD,VHO,VAO

Additional Analyses are added to Specific Borings at Specified Depths.

EXPLANATION

- ● Phase I Boring
- ▲ Phase II Boring
- — — Revised Site Boundary
- (BWT) Below Water Table

ABBREVIATION KEY

VHO	Volatile Halo-Organic Compounds
VAO	Volatile Aromatic Organic Compounds
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides
OSC	Organosulfur Compounds
Hg	Mercury
ICP	Metals (Cd, Cr, Cu, Pb, Zn)
As	Arsenic
VOL	Volatile Organic Compounds
SVO	Semivolatile Organic Compounds
TDG	Thiodiglycol (Mustard Degradation Products)
IMPA	Isopropylmethylphosphonic Acid (GB Degradation Products)

N

0 100 200 300 feet

SCALE

Figure 36-3-8
PROPOSED PHASE II INVESTIGATION, BORING LOCATION MAP, SITE 36-3
SOURCE: ESE, 1987

Prepared for:
U.S. Army Program Manager's Office For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

The proposed analytical program for the Phase II investigation is summarized below:

Analytical Method	Number of Samples
Volatile Halo-organic Compounds	47
Volatile Aromatic Organic Compounds	47
Organochlorine Pesticides	75
Organophosphorous Pesticides	75
Organosulfur Compounds	75
DBCP	75
DCPD/BCHD	75
Mercury	28
Volatile Organic Compounds (GC/MS)	10
Semivolatile Organic Compounds (GC/MS)	14
Thiodiglycol and IMPA	10

The suite of Phase II analyses has been selected based on the Phase I analytical results. Phase I results indicate that a wide range of compounds are present. Concentrations between boreholes and sample intervals are relatively variable and possibly result from the type of disposal activity at this site. Widespread detection of various pesticides necessitates the analysis of every sample collected for organochlorine pesticides, organosulfur, and organophosphorous pesticides. The presence of DBCP in the 0- to 1-ft interval of Borings 3177 and 3179 and the detection of other volatile organic compounds in soil samples from Boring 3176 indicate that soil in all but surface horizons may contain volatile organic compounds. All soil samples in Phase II, with the exception of 0- to 1-ft samples, will be analyzed for volatile halo-organic and aromatic organic compounds. With the exception of mercury, Phase I soil samples did not contain any significant metal concentrations; therefore, these analytes will not be measured. Mercury will be analyzed only in 0- to 1-ft samples, as no mercury above the indicator range was detected at depth.

In addition, many of the samples analyzed from this site contained such high concentrations of compounds that they required dilution in the laboratory prior to analysis. Because dilution effectively raises the method detection limit, some compounds may have been present but were undetectable at the higher limits. For this reason, a full range of analyses is being performed on Phase II samples in order to detect any analytes that may not have been found in the Phase I investigation. Specific analyses for thiodiglycol and isopropylmethylphosphonic acid (IMPA) and GC/MS for volatile and extractable organic compounds will be conducted on selected samples in accordance with protocol established by PMO-RMA. A minimum of 10 percent confirmation samples will be run by GC/MS (Figure 36-3-8). The samples to be confirmed will be used not only to confirm the identification of target analytes but also to identify other compounds that may be present. In this way the compounds found in the Phase I nontarget survey can be identified and any distribution trends noted. The Phase II sampling plan is presented in Figure 36-3-8.

The draft version of this report and the proposed Phase II program were reviewed in an onpost MOA meeting of August 21, 1986. Comments were received from the Colorado Department of Health on July 16, 1986, and from Shell Chemical Company on August 7, 1986. These comments were considered in the preparation of this final report and are presented with responses in Appendix 36-3-C. U.S. Environmental Protection Agency (USEPA) comments are an integral part of the review process and previously have been incorporated into this report.

3.4 QUANTITY OF POTENTIALLY CONTAMINATED SOIL

The quantity of potentially contaminated soil was revised on the basis of Phase I sampling results and the geophysical investigation. Geophysical results indicate that the areal extent of the site is larger than previously estimated. Results of the chemical analysis and field observations made during the drilling program show that the average depths of the trenches are somewhat shallower. The revised estimates of

potentially contaminated soil at this site encompass an areal extent of 247,000 ft^2, the area shown by the revised site boundaries (Figure 36-3-8). The average estimated depth of the trenches is 8 ft, thus an estimated volume of 73,000 bcy of potentially contaminated soil exists at this site.

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COLORADO DEPARTMENT OF HEALTH
Richard D. Lamm
Governor

Thomas M. Vernon, M.D.
Executive Director

July 16, 1986

Mr. Donald Campbell
Office of the Program Manager
AMXRM-EE, Bldg. 4585
Aberdeen Proving Ground
Maryland 21010-5401

Dear Mr. Campbell:

Enclosed are our comments on the Phase II Section 36 Draft Final Source Reports, 36-UNC, 36-3, 36-17 and Draft Final Source Reports 1-1, 1-9, 2-1, 2-13, and 2-14.

If you have any issues concerning the comments that you would like to discuss, please contact Mr. Chris Sutton with the Water Quality Control Division.

Sincerely,

Tom Looby

Thomas P. Looby
Remedial Programs Director
Office of Health Protection

TPL:CR/lre

Enclosure

cc: Robert Duprey, EPA
Howard Kenison, AGO
Bob Lundahl, Shell Chemical Co.

4210 EAST 11TH AVENUE DENVER COLORADO 80220 PHONE

COLORADO DEPARTMENT OF HEALTH

SPECIFIC COMMENTS

FINAL SITE 36-3 REPORT

TASK 1 INSECTICIDE PIT

1. P. 36-3-1 — According to a February 1982 report entitled "Assessment of Historical Waste Disposal in Section 36 of RMA," the depth of these pits could extend to 11 ft below surface, the average depth of contaminated soils is 24 ft and therefore the net volume of contaminated soils would be approximately 185,000 cubic yards. Please explain the nearly 10 fold discrepancy in the estimates presented in the draft source report.

2. P. 36-3-1 — There is no appendix included with this draft final source report.

3. P. 36-3-15 — Since it was known that substantial quantities of volatile organic compounds were disposed in Source 36-3, what was the justification for only analyzing volatile organics in two samples? Phase II investigations must correct this problem.

4. P. 36-3-15 — Since it was known that the trenches extended at least to 10 ft and probably deeper, none of the Phase I borings extended thru the trenches to evaluate the extent of soil contamination with depth. Phase II investigations must be designed to correct this oversight.

5. P. 36-3-16 — Please provide the document "Geophysical Investigation of Contaminant Sources 36-3, 36-10, and 36-17.

6. P. 36-3-16 — What was the basis for the interpretation that the bottom of the trench at Boring 3178 was 9 ft?

7. P. 36-3-22 — Figure 36-3-10 should be corrected to show contaminants at or in excess of the revised indicator levels for metals.

8. P. 36-3-20 — Table 36-3-3 should differentiate when samples are not analyzed for a particular class of organic chemicals such as volatiles.

9. P. 36-3-23 — Inorganic determinations also revealed arsenic and zinc contamination at or in excess of indicator levels.

10. P. 36-3- 23 — Hexachlorobenzene should be included in the Phase II analyte list since it was identified in the northern limits of the study area at higher concentrations than the target compound Dieldrin and it is considered to be very toxic.

11. P. 36-3-23 — The discussion of the Phase I contamination assessment should note that volatile organic contamination was found in the deeper sampling interval. Inorganic contaminants at or in excess of the indicator levels were found with depth in Borings 3173 (As), 3176 (Cd), 3177 (Hg&Cd), 3178 (Hg), and 3179 (Hg).

12. P. 36-3-27 — The discussion states that boreholes 3176 and 3177 "did not encounter trench material nor were any high concentrations of contaminants detected." This statement must be erroneous since these two borings encountered the highest levels of contaminants found in the study area.

13. P. 36-3-31 — Another objective of the Phase II Program must be to define the vertical extent of contamination of the source. Since the highest contamination has

been identified in the deepest intervals sampled, it appears the contaminant concentrations are increasing with depth. Verification of previous extent of soil contamination (to 24 ft) must be made during Phase II to allow for an accurate feasibility assessment for remediation of this source. Some Phase II borings must extend to at least 25 ft below surface in the same vicinity of Borings 3176 and 3177. Perimeter borings should extend to at least 15 ft below surface on the south and to 20 ft below surface on the north, and northwest to define if significant soil contamination has migrated to these depths.

14. P. 36-3-34 — Mercury was detected at or above the indicator level in the deeper intervals of borings 3177, 3178, and 3179. Mercury analyses should be continued in the deeper sampling intervals.

15. P. 36-3-34 — The raw data should be appended to the source reports as has been done for previous reports.

FINAL RESPONSE TO SPECIFIC COMMENTS OF COLORADO DEPARTMENT OF HEALTH FINAL SITE 36-3 REPORT TASK 1 INSECTICIDE PIT

The following responses address the preceding specific comments from Colorado Department of Health on the final Site 36-3 Report.

1. P. 36-3-1 — The volume estimated in this report is for soil above the water table. We cannot speak for the basis of estimates provided by others; however, the referenced report is 4 years old and thus did not have the benefit of research and data collected since that time.

2. P. 36-3-1 — The appendix was sent separately and is included with the final report in an updated format.

3. P. 36-3-15 — Volatiles disposal was not "known" by us, nor indicated by available reference materials at the time Phase I was designed. The Phase II plan includes additional volatile analyses at deep intervals to further investigate the possible presence of these compounds as indicated by Phase I.

4. P. 36-3-15 — Boring 3178 did penetrate a trench bottom at approximately 9 ft. All borings in Phase I were completed according to established protocols. Phase II will include sampling to 15 ft, which is below the water table and the indicated depth of trenching.

5. 36-3-16 — The requested draft document, which provides a complete description of the geophysical studies at this site, has been provided. This information was an important part of formulating the Phase II plan.

6. 36-3-16 — Visual inspection of the soil column by the field geologist was the basis for locating the trench bottom. Obvious waste material was present to that depth.

7. 36-3-22 — The figure has been revised as requested and now shows values within or above the established indicator ranges.

8. 36-3-20 — The table has been revised as requested to clearly indicate when samples were not analyzed and when analysis was performed but no detections were made.

9. P. 36-3-23 — Correct. Arsenic and zinc were detected, and this information has been added to figures and tables where appropriate.

10. P. 36-3-23 — Phase II includes further examination of the distribution of volatile organic compounds in the area in question.

11. P. 36-3-23 — The discussion has been revised to specifically note the distribution of organic and inorganic constituents.

12. P. 36-3-27 — The boring numbers were incorrect and have been changed.

13. P. 36-3-31 — Phase II objectives are clearly defined. The recommendations presented for sampling to "at

least 25 ft" are not considered justified. Phase II does include sampling to 15 ft, which is below the water table contact. Separate efforts are underway to examine ground water quality and soil and ground water interactions in Section 36.

14. P. 36-3-34 — The observed mercury values are within the indicator range. Deep sampling for mercury is not considered necessary or appropriate based on this data.

15. P. 36-3-34 — A complete listing of chemical data obtained for this site is appended.

Shell Oil Company

One Shell Plaza
P.O. Box 4320
Houston, Texas 77210

August 7, 1986

USATHAMA
Office of the Program Manager
Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE: Chief: Mr. Donald L. Campbell
Bldg E4585, Trailer
Aberdeen Proving Ground, MD 21010-5401

Dear Mr. Campbell:

Enclosed herewith are Shell's comments on the draft final copies of Contamination Assessment Reports for Sources 36-UNC, 36-3, and 36-17. In addition to these specific comments, the general comments on methodology and data presentation, which were made in Shell's April 7, 1986 response to Section 36 Contamination Assessment Reports, apply as well to these reports.

The geophysical investigation performed to define the dimensions of pits and trenches are an integral part of the Phase I investigation of Sources 36-3 and 36-17. Unfortunately, these investigations are summarized in a separate report, "Geophysical Investigation of Contaminant Sources 36-3, 36-10 and 36-17" (ESE, 1986), which has not been provided to Shell. Without this report as a reference, the text of the Source 36-3 and 36-17 Phase I reports are confusing with respect to the approach to and results of defining the orientation and dimensions of disposal trenches. Shell requests a copy of this report. Based on its review of this report, Shell may submit additional comments on Sources 36-3 and 36-17.

Based on the intensive trench disposal activities in the Source 36-3 and 36-17 areas, it is obvious that these are two areas will require close scrutiny. Shell believes that substantially more borings are warranted than are proposed in the Phase II plans for these sources.

Very truly yours,

for C. K. Hahn
Denver Site Project

RDL:ajg

Enclosure

cc: See attached

BIHM8621907

cc: USATHAMA
Office of the Program Manager
Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE: Mr. Kevin T. Blose
Bldg E4585, Trailer
Aberdeen Proving Ground, MD 21010-5401

Mr. Thomas Bick
Environmental Enforcement Section
U.S. Department of Justice
P.O. Box 23896
Benjamin Franklin Station
Washington, D.C. 20026

Major Robert J. Boonstoppel
Headquarters - Department of the Army
ATTN: DAJA-LTS
Washington, DC 20310-2210

SHELL OIL COMPANY

SPECIFIC COMMENTS ON THE FINAL SITE 36-3 REPORT

TASK 1 INSECTICIDE PIT

1. P. 36-3-16 — The document "Geophysical Investigation of Contaminant Sources 36-3, 36-10, and 36-17" (ESE, 1986) should be distributed to the MOA parties for review and comment.

2. P. 36-3-6, 2.2 — Army Reports (e.g., RIC#82235R02) state that trenching activity is evident in 36-3 based on a 1948 aerial photograph.

3. Table 36-3-2 — The detection limit shown for PCPMS appears to be in error.

4. Table 36-3-3, p.1 — The symbol -- (Below Detection Limit) is misapplied under Volatiles since only 3176C was analyzed for volatiles.

5. Table 36-3-3, p.2 — The notation "None Detected" under Volatiles applies only to 3178C since none of the other samples were analyzed for volatiles.

6. P. 35-3-23 — Last sentence of first paragraph. Arsenic was detected in 5 out of 16 samples.

7. P. 36-3-23 — Last Paragraph. The statement that four borings contain only surface contamination is misleading. Of thse four, two were sampled only at the 0-1 ft level and the other two at the 0-1 and 4-5 ft levels.

   Re second sentence, of the seven surface interval samples referred to as indicating wide distribution of organochloride pesticides and DBCP, four yielded positive detection of dieldrin only.

8. P. 36-3-27 — First full paragraph. The statement that there were no high concentrations of contaminants detected in borings 3175, 3176, and 3177 is questionable.

9. P. 36-3-33 — Arsenic should be added to list of analytes for shallow intervals. All borings should be to the 10 or 15 ft level.

FINAL RESPONSE TO SPECIFIC COMMENTS OF SHELL OIL COMPANY
FINAL SITE 36-3 REPORT
TASK 1 INSECTICIDE PITS

General comments made in the cover letter by Shell Oil Company were discussed at the MOA meeting on August 21, 1986. A final reponse to these general comments is included within the minutes of the MOA meeting. The following responses address the preceding specific comments from Shell Oil Company on the final Site 36-3 Report.

1.	P. 36-3-16	The requested draft document, which provides a complete description of the geophysical studies at this site, has been provided. This information was an important part of formulating the Phase II plan.
2.	P. 36-3-6, 2.2	The referenced activity could not be substantiated. Our examination of the 1948 photograph showed no evidence of activity at this site.
3.	Table 36-3-2	The correct CPMS detection limit is 0.3 ppm, and appropriate changes have been made in the text and tables.
4.	Table 36-3-3,p.1	The referenced table has been revised to distinguish between not analyzed and not detected.
5.	Table 36-3-3,p.2	The referenced table has been revised to distinguish between not analyzed and not detected.
6.	P. 36-3-23	The text has been revised to enumerate and identify borings with values within indicator ranges and those above ranges.

7. P. 36-3-23 — The text has been revised to eliminate vague statements and to note specifically the occurrence and distribution of various analytes.

8. P. 36-3-27 — The boring numbers referenced were incorrect and have been revised.

9. P. 36-3-33 — We do not see adequate justificaiton for expanding the analytical list to include arsenic based on the Phase I data, which showed all arsenic values to be at the lower end of the indicator range. Selected boring depths have been extended, with some extending to 15 ft, which is below the water table contact.

Sampson, J.S. and Baber, T.G. 1974. Soil Survey of Adams County, Colorado. U.S. Soil Conservation Service (SCS). 77 pp. Plus maps.

RIC#83368R01
Stout, K., Abbott, L., and Webb, V. 1982. Installation Assessment Report, Rocky Mountain Arsenal. Vols. I and II. U.S. Environmental Protection Agency (USEPA).

U.S. Army Materiel Development and Readiness Command (USAMDARC). 1979. Safety Regulations for Chemical Agent H. DARCOM-R 385-31. Department of the Army.

U.S. Army Materiel Development and Readiness Command (USAMDARC). 1982. Safety Regulations for Chemical Agents GB and VX. DARCOM-R 385-102. Department of the Army.

APPENDIX 36-3-A

CHEMICAL NAMES AND ABBREVIATIONS

APPENDIX 36-3-A
CHEMICAL NAMES AND ABBREVIATIONS

All 16 soil samples collected during the Site 36-3 Phase I boring program were analyzed for semivolatile organic compounds, ICP metals, arsenic, mercury, and DBCP. Two of these samples were also analyzed for volatile organic compounds. The Phase I analytes are listed below:

Analytes	Synonymous Names Used in Appendix B	Abbreviations
Volatile Organics		
Trans 1,2-dichloroethene	Trans 1,2-dichloroethene	T12DCE
Ethylbenzene	Ethylbenzene	$ETCC_6H_5$
Methylene chloride	Methylene chloride	CH_2CL_2
Tetrachloroethene (PCE)	Tetrachloroethene	TCLEE
Toluene	Toluene	MEC_6H_5
1,1,1-Trichloroethane (TCA)	1,1,1-Trichloroethane	111TCE
1,1,2-Trichloroethane	1,1,2-Trichloroethane	112TCE
Trichloroethene (TCE)	Trichloroethene	TRCLE
m-Xylene	m-Xylene	XYLEN
Methylisobutyl ketone	MIBK	MIBK
Dimethyldisulfide	DMDS	DMDS
Benzene	Benzene	C_6H_6
o,p-Xylene	o- and/or p-Xylene	XYLEN
Carbon tetrachloride	Carbon tetrachloride	CCL_4
Chlorobenzene	Chlorobenzene	CLC_6H_5
Chloroform	Chloroform	$CHCL_3$
1,1-Dichloroethane	1,1-Dichloroethane	11DCLE
1,2-Dichloroethane	1,2-Dichloroethane	12DCLE
Bicycloheptadiene	Bicycloheptadiene	BCHD
Semivolatile Organics		
Aldrin	Aldrin	ALDRN
Endrin	Endrin	ENDRN
Dieldrin	Dieldrin	DLDRN
Isodrin	Isodrin	ISODR
p,p'-DDT	Dichlorodiphenyltrichloroethane	PPDDT
p,p'-DDE	Dichlorodiphenylethane	PPDDE
Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	CL_6CP
1,4-Oxathiane	1,4-Oxathiane	OXAT
Dithiane	Dithiane	DITH
Malathion	Malathion	MLTHN
Parathion	Parathion	PRTHN
Chlordane	Chlordane	CLDAN
Supona	2-Chloro-1(2,4-dichlorophenyl) vinyldiethyl phosphate	SUPONA
Diisopropylmethyl phosphonate	Diisopropylmethyl phosphonate	DIMP
Dimethylmethyl phosphonate	Dimethylmethyl phosphonate	DMMP
Atrazine	Atrazine	ATZ
Dicyclopentadiene	Dicyclopentadiene	DCPD
Vapona	Vapona	DDVP

APPENDIX 36-3-A
CHEMICAL NAMES AND ABBBREVIATIONS

Analytes	Synonymous Names Used in Appendix B	Abbreviations
Semivolatile Organics (Cont)		
Chlorophenylmethyl sulfide	p-Chlorophenylmethyl sulfide	CPMS
Chlorophenylmethyl sulfoxide	p-Chlorophenylmethyl sulfoxide	CPMSO
Chlorophenylmethyl sulfone	p-Chlorophenylmethyl sulfone	$CPMSO_2$
Dibromochloropropane	Dibromochloropropane	DBCP
ICP Metals Screen		
Chromium	Chromium	CR
Zinc	Zinc	ZN
Cadmium	Cadmium	CD
Copper	Copper	CU
Lead	Lead	PB
Separate Analyses		
Arsenic	Arsenic	AS
Mercury	Mercury	HG
Dibromochloropropane	Dibromochloropropane	DBCP

APPENDIX 36-3-B

PHASE I CHEMICAL DATA

ENVIRONMENTAL SCIENCE & ENGINEERING 01/28/87 STATUS: ACTIVE PAGE# 1

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

							SAMPLE ID/#							
		3173A	3173B	3174A	3175A	3175B	3176A	3176B	3176C	3177A	3177B	3178A	3178B	3178C	3179A
PARAMETERS	STORET #	5097	5097	5097	5097	5097	5097	5097	5097	5097	5097	5097	5097	5097	5097
UNITS	METHOD	0	1	6	12	13	18	19	20	24	25	30	31	32	36
DATE		05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/15/85	05/15/85	05/15/85	05/14/85
TIME		10:49	10:58	07:52	13:26	13:28	08:40	09:06	09:24	15:01	15:12	08:46	08:51	09:23	13:57
SAMPLE TYPE	71999	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
	0														
SAMPLE DEPTH	99758A	0.0	4.00	0.0	0.0	4.00	0.0	4.00	9.00	0.0	4.00	0.0	4.00	9.00	0.0
FT	0														
SITE TYPE 1	99759	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
	0														
INSTALLATION CODE	99720	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK
SAMPLE	0														
SAMPLING TECHNIQUE	72005	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	0														
COORDINATE,N/S	98392	181729	181729	181741	181640	181640	181642	181642	181642	181548	181548	181557	181557	181557	181460
STP	0														
COORDINATE,E/W	98393	2186305	2186305	2186794	2186201	2186201	2186581	2186581	2186581	2186400	2186400	2186779	2186779	2186779	2186301
STP	0														
MOISTURE	70320	7.4	13.1	9.1	10.8	16.2	9.0	6.0	20.0	12.1	17.8	10.3	14.2	12.8	14.5
%WET WT	0														
CADMIUM	1028	<0.900	<0.900	1.00	1.00	<0.900	3.50	1.00	1.30	<0.900	1.10	1.50	<0.900	<0.900	<0.900
UG/G- DRY	0														
CHROMIUM	99584	12.0	16.0	10.0	12.0	<7.00	11.0	9.00	<7.00	10.0	<7.00	12.0	16.0	10.0	14.0
UG/G-DRY	0														
COPPER	1043	8.00	9.00	8.00	10.0	<5.00	7.00	6.00	<5.00	7.00	<5.00	8.00	10.0	6.00	11.0
UG/G- DRY	0														
LEAD	1052	<17.0	18.0	<17.0	39.0	<17.0	<17.0	<17.0	26.0	<17.0	<17.0	20.0	19.0	<17.0	22.0
UG/G-DRY	0														
ZINC	1093	36.0	43.0	34.0	43.0	20.0	36.0	27.0	20.0	37.0	16.0	41.0	54.0	36.0	54.0
UG/G-DRY	0														
ARSENIC	1003	5.10	4.90	<4.70	5.30	<4.70	<4.70	<4.70	<4.70	<4.70	<4.70	5.10	<4.70	<4.70	<4.70
UG/G- DRY	0														
MERCURY	71921	<0.050	<0.050	0.070	0.450	<0.050	0.090	<0.050	<0.050	0.070	0.100	0.240	0.060	<0.050	0.060
UG/G-DRY	0														
ALDRIN	98356	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	113	2.98	<0.900	<0.900	<0.900	1.18	<0.900
UG/G- DRY	0														
DIELDRIN	98365	0.439	<0.300	2.57	3.08	<0.300	<0.300	<0.300	6.61	17.9	0.866	1.93	<0.300	7.46	0.476
UG/G-DRY	0														
DDT,PP'	98364	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
UG/G-DRY	0														
ENDRIN	98369	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	3.12	9.29	10.1	<0.700	<0.700	2.29	<0.700
UG/G-DRY.	0														
CHLORDANE	98361	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
UG/G- DRY	0														

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

PARAMETERS	STORET #	SAMPLE ID/# 3173A 5097	3173B 5097	3174A 5097	3175A 5097	3175B 5097	3176A 5097	3176B 5097	3176C 5097	3177A 5097	3177B 5097	3178A 5097	3178B 5097	3178C 5097	3179A 5097
UNITS	METHOD	0	1	6	12	13	18	19	20	24	25	30	31	32	36
DATE		05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/15/85	05/15/85	05/15/85	05/14/85
TIME		10:49	10:58	07:52	13:26	13:28	08:40	09:06	09:24	15:01	15:12	08:46	08:51	09:23	13:57
DDE,PP'	98363	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0														
1,4 OXATHIANE	98644	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0														
DIMP	98645	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
UG/G-DRY	0														
VAPONA	98646	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
UG/G -DRY	0														
HEXACHLOROCYCLOPENT-	98647	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
ADIENE UG/G-DRY	0														
MALATHION	98648	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600
UG/G-DRY	0														
ISODRIN	98649	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	17.6	25.2	<0.300	<0.300	<0.300	0.610	<0.300
UG/G-DRY	0														
1,4 DITHIANE	98650	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
UG/G- DRY	0														
DICYCLOPENTADIENE	98651	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	24.9	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0														
DBCP(NEMAGON)	98652	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.19	0.013	0.330	<0.005	<0.005	0.009	0.055
UG/G-DRY	0														
P-CLPHENYLMETHYL-	98653	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
SULFIDE UG/G-DRY	0														
P-CLPHENYLMETHYL-	98654	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	1.32
SULFOXIDE UG/G-DRY	0														
ATRAZINE	98655	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
UG/G-DRY	0														
SUPONA	98656	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
UG/G-DRY.	0														
DMMP	98657	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
UG/G-DRY	0														
PARATHION	98658	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
UG/G-DRY	0														
P-CLPHENYLMETHYL-	98703	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
SULFONE UG/G-DRY	0														
TRANS-1,2-DICHLORO-	98687	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
ETHENE UG/G-DRY	0														
ETHYLBENZENE	98688	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
METHYLENE CHLORIDE	98689	NA	NA	NA	NA	NA	NA	NA	1.32	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

PARAMETERS	STORET #	SAMPLE ID/# 3173A	3173B	3174A	3175A	3175B	3176A	3176B	3176C	3177A	3177B	3178A	3178B	3178C	3179A
UNITS	METHOD	5097 0	5097 1	5097 6	5097 12	5097 13	5097 18	5097 19	5097 20	5097 24	5097 25	5097 30	5097 31	5097 32	5097 36
DATE		05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/15/85	05/15/85	05/15/85	05/14/85
TIME		10:49	10:58	07:52	13:26	13:28	08:40	09:06	09:24	15:01	15:12	08:46	08:51	09:23	13:57
TETRACHLOROETHENE	98690	NA	NA	NA	NA	NA	NA	NA	0.601	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
TOLUENE	98691	NA	NA	NA	NA	NA	NA	NA	7.80	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
1,1,1-TRICHLORO-ETHANE	98692	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
1,1,2-TRICHLORO-ETHANE	98693	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
TRICHLOROETHENE	98694	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
M-XYLENE	98695	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
MIBK	98696	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
DMDS	98697	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
BENZENE	98699	NA	NA	NA	NA	NA	NA	NA	0.887	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
O-AND/OR P-XYLENE	98700	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
CARBON TETRACHLORIDE	98680	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
CHLOROBENZENE	98681	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
CHLOROFORM	98682	NA	NA	NA	NA	NA	NA	NA	1.68	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
1,1-DICHLOROETHANE	98683	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
1,2-DICHLOROETHANE	98684	NA	NA	NA	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
BICYCLOHEPTADIENE	98686	NA	NA	NA	NA	NA	NA	NA	1.08	NA	NA	NA	NA	<0.500	NA
UG/G-DRY	0														
DBCP(NEMAGON)	98652	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.2	0.01	0.33	<0.005	<0.005	0.009	0.06
UG/G-DRY	Q9														
DBCP	98652	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.19	0.013	0.330	<0.005	<0.005	0.009	0.055
UG/G-DRY	H9														
UNK518	90013														
UG/G	0														
UNK542	90024														
UG/G	0														

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

PARAMETERS	UNITS	STORET # METHOD	SAMPLE ID/# 3173A 5097 0	3173B 5097 1	3174A 5097 6	3175A 5097 12	3175B 5097 13	3176A 5097 18	3176B 5097 19	3176C 5097 20	3177A 5097 24	3177B 5097 25	3178A 5097 30	3178B 5097 31	3178C 5097 32	3179A 5097 36
DATE			05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/15/85	05/15/85	05/15/85	05/14/85
TIME			10:49	10:58	07:52	13:26	13:28	08:40	09:06	09:24	15:01	15:12	08:46	08:51	09:23	13:57
UNK619		90105														
	UG/G	0														
UNK535		90093	1.02		1.18											
	UG/G	0														
UNK554		90096	0.597													
	UG/G	0														
UNK596		90055	6.20		9.14											
	UG/G	0														
UNK614		90070	3.14		4.07											
	UG/G	0														
UNK629		90082	1.13							8.38						
	UG/G	0														
UNK585		90102		0.937												
	UG/G	0														
UNK591		90051			4.85											
	UG/G	0														
UNK551		90095								8.12						
	UG/G	0														
UNK577		90041								12.1						
	UG/G	0														
UNK580		90044								23.1						
	UG/G	0														
UNK631		90083								7.53						
	UG/G	0														
UNK581		90101													1.83	
	UG/G	0														
UNK630		90106									4.22				51.0	
	UG/G	0														
UNK618		90073									3.78					
	UG/G	0														
UNK625		90078									1.93					
	UG/G	0														
UNK633		90085									10.5					
	UG/G	0														
UNK635		90087									1.58					
	UG/G	0														
UNK561		90032										0.828				
	UG/G	0														
UNK522		90014														
	UG/G	0														

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

PARAMETERS	UNITS	STORET # / METHOD	SAMPLE ID/# 3173A 5097 0	3173B 5097 1	3174A 5097 6	3175A 5097 12	3175B 5097 13	3176A 5097 18	3176B 5097 19	3176C 5097 20	3177A 5097 24	3177B 5097 25	3178A 5097 30	3178B 5097 31	3178C 5097 32	3179A 5097 36
DATE			05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/14/85	05/15/85	05/15/85	05/15/85	05/14/85
TIME			10:49	10:58	07:52	13:26	13:28	08:40	09:06	09:24	15:01	15:12	08:46	08:51	09:23	13:57
UNK547		90094														
	UG/G	0														
UNK593		90052														
	UG/G	0														
UNK603		90060														
	UG/G	0														
UNK616		90104														
	UG/G	0														
UNK601		90058														
	UG/G	0														
UNK187		90131								25.5						
	UG/G	0														

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

SAMPLE ID/#

PARAMETERS	STORET #	3179B 5097	3180A 5097	BLANK 5097	BLANK 5097
UNITS	METHOD	37	42	80	81
DATE		05/14/85	05/14/85	05/14/85	05/14/85
TIME		14:03	15:54	00:00	00:00
SAMPLE TYPE	71999 0	SO	SO	SO	SO
SAMPLE DEPTH	99758A	3.00	0.0	0.0	0.0
FT	0				
SITE TYPE 1	99759 0	BORE	BORE	QCMB	QCMB
INSTALLATION CODE	99720	RK	RK	RK	RK
SAMPLE	0				
SAMPLING TECHNIQUE	72005 0	S	S	G	G
COORDINATE,N/S	98392	181460	181460	NA	NA
STP	0				
COORDINATE,E/W	98393	2186301	2186599	NA	NA
STP	0				
MOISTURE	70320	19.7	18.0	2.3	2.3
%WET WT	0				
CADMIUM	1028	<0.900	<0.900	NA	NA
UG/G- DRY	0				
CHROMIUM	99584	14.0	21.0	NA	NA
UG/G-DRY	0				
COPPER	1043	8.00	29.0	NA	NA
UG/G- DRY	0				
LEAD	1052	17.0	68.0	NA	NA
UG/G-DRY	0				
ZINC	1093	47.0	65.0	NA	NA
UG/G-DRY	0				
ARSENIC	1003	<4.70	5.10	NA	NA
UG/G- DRY	0				
MERCURY	71921	0.060	0.430	NA	NA
UG/G-DRY	0				
ALDRIN	98356	<0.900	7.36	<0.900	<0.900
UG/G- DRY	0				
DIELDRIN	98365	<0.300	9.05	<0.300	<0.300
UG/G-DRY	0				
DDT,PP'	98364	<0.400	<0.400	<0.400	<0.400
UG/G-DRY	0				
ENDRIN	98369	<0.700	2.55	<0.700	<0.700
UG/G-DRY.	0				
CHLORDANE	98361	<1.00	<1.00	<1.00	<1.00
UG/G- DRY	0				

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

SAMPLE ID/#

PARAMETERS	STORET #	3179B 5097	3180A 5097	BLANK 5097	BLANK 5097
UNITS	METHOD	37	42	80	81
DATE		05/14/85	05/14/85	05/14/85	05/14/85
TIME		14:03	15:54	00:00	00:00
DDE,PP'	98363	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0				
1,4 OXATHIANE	98644	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0				
DIMP	98645	<0.500	<0.500	<0.500	<0.500
UG/G-DRY	0				
VAPONA	98646	<0.300	<0.300	<0.300	<0.300
UG/G -DRY	0				
HEXACHLOROCYCLOPENT-	98647	<1.00	<1.00	<1.00	<1.00
ADIENE UG/G-DRY	0				
MALATHION	98648	<0.600	<0.600	<0.600	<0.600
UG/G-DRY	0				
ISODRIN	98649	<0.300	0.519	<0.300	<0.300
UG/G-DRY	0				
1,4 DITHIANE	98650	<0.300	<0.300	<0.300	<0.300
UG/G- DRY	0				
DICYCLOPENTADIENE	98651	<0.300	<0.300	<0.300	<0.300
UG/G-DRY	0				
DBCP(NEMAGON)	98652	2.15	<0.005	<0.005	NA
UG/G-DRY	0				
P-CLPHENYLMETHYL-	98653	2.52	<0.300	<0.300	<0.300
SULFIDE UG/G-DRY	0				
P-CLPHENYLMETHYL-	98654	1.92	<0.400	<0.400	<0.400
SULFOXIDE UG/G-DRY	0				
ATRAZINE	98655	<0.700	<0.700	<0.700	<0.700
UG/G-DRY	0				
SUPONA	98656	<0.500	<0.500	<0.500	<0.500
UG/G-DRY.	0				
DMMP	98657	<2.00	<2.00	<2.00	<2.00
UG/G-DRY	0				
PARATHION	98658	<0.700	<0.700	<0.700	<0.700
UG/G-DRY	0				
P-CLPHENYLMETHYL-	98703	19.4	<0.300	<0.300	<0.300
SULFONE UG/G-DRY	0				
TRANS-1,2-DICHLORO-	98687	NA	NA	<0.500	NA
ETHENE UG/G-DRY	0				
ETHYLBENZENE	98688	NA	NA	<0.500	NA
UG/G-DRY	0				
METHYLENE CHLORIDE	98689	NA	NA	<0.500	NA
UG/G-DRY	0				

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
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SAMPLE ID/#

PARAMETERS / UNITS	STORET # / METHOD	3179B 5097 37	3180A 5097 42	BLANK 5097 80	BLANK 5097 81
DATE		05/14/85	05/14/85	05/14/85	05/14/85
TIME		14:03	15:54	00:00	00:00
TETRACHLOROETHENE	98690	NA	NA	<0.500	NA
UG/G-DRY	0				
TOLUENE	98691	NA	NA	<0.500	NA
UG/G-DRY	0				
1,1,1-TRICHLORO-ETHANE	98692	NA	NA	<0.500	NA
UG/G-DRY	0				
1,1,2-TRICHLORO-ETHANE	98693	NA	NA	<0.500	NA
UG/G-DRY	0				
TRICHLOROETHENE	98694	NA	NA	<0.500	NA
UG/G-DRY	0				
M-XYLENE	98695	NA	NA	<0.500	NA
UG/G-DRY	0				
MIBK	98696	NA	NA	<0.500	NA
UG/G-DRY	0				
DMDS	98697	NA	NA	<0.500	NA
UG/G-DRY	0				
BENZENE	98699	NA	NA	<0.500	NA
UG/G-DRY	0				
O-AND/OR P-XYLENE	98700	NA	NA	<0.500	NA
UG/G-DRY	0				
CARBON TETRACHLORIDE	98680	NA	NA	<0.500	NA
UG/G-DRY	0				
CHLOROBENZENE	98681	NA	NA	<0.500	NA
UG/G-DRY	0				
CHLOROFORM	98682	NA	NA	<0.500	NA
UG/G-DRY	0				
1,1-DICHLOROETHANE	98683	NA	NA	<0.500	NA
UG/G-DRY	0				
1,2-DICHLOROETHANE	98684	NA	NA	<0.500	NA
UG/G-DRY	0				
BICYCLOHEPTADIENE	98686	NA	NA	<0.500	NA
UG/G-DRY	0				
DBCP(NEMAGON)	98652	2.2	<0.005	<0.005	NA
UG/G-DRY	Q9				
DBCP	98652	2.15	<0.005	<0.005	NA
UG/G-DRY	H9				
UNK518	90013			0.249	
UG/G	0				
UNK542	90024			0.288	
UG/G	0				

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PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

SAMPLE ID/#

PARAMETERS	UNITS	STORET # / METHOD	3179B 5097 37	3180A 5097 42	BLANK 5097 80	BLANK 5097 81
DATE			05/14/85	05/14/85	05/14/85	05/14/85
TIME			14:03	15:54	00:00	00:00
UNK619		90105		1.06	0.162	
	UG/G	0				
UNK535		90093				
	UG/G	0				
UNK554		90096				
	UG/G	0				
UNK596		90055				
	UG/G	0				
UNK614		90070				
	UG/G	0				
UNK629		90082				
	UG/G	0				
UNK585		90102				
	UG/G	0				
UNK591		90051				
	UG/G	0				
UNK551		90095				
	UG/G	0				
UNK577		90041				
	UG/G	0				
UNK580		90044				
	UG/G	0				
UNK631		90083				
	UG/G	0				
UNK581		90101				
	UG/G	0				
UNK630		90106				
	UG/G	0				
UNK618		90073				
	UG/G	0				
UNK625		90078				
	UG/G	0				
UNK633		90085				
	UG/G	0				
UNK635		90087				
	UG/G	0				
UNK561		90032				
	UG/G	0				
UNK522		90014	0.785			
	UG/G	0				

PROJECT NUMBER 84936 0300 PROJECT NAME SECTION 36 RMA
FIELD GROUP 36 3A PROJECT MANAGER BILL FRASER
5097S LAB COORDINATOR PAUL GEISZLER

SAMPLE ID/#

PARAMETERS	UNITS	STORET # / METHOD	3179B 5097 37	3180A 5097 42	BLANK 5097 80	BLANK 5097 81
DATE			05/14/85	05/14/85	05/14/85	05/14/85
TIME			14:03	15:54	00:00	00:00
UNK547		90094	1.84			
	UG/G	0				
UNK593		90052	0.910			
	UG/G	0				
UNK603		90060	0.285	0.763		
	UG/G	.0				
UNK616		90104	0.630			
	UG/G	0				
UNK601		90058		2.67		
	UG/G	0				
UNK187		90131				
	UG/G	0				